TELEPHONE ENGINEER

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FEBRUARY 1937

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TELEPHONE TRANSMISSION THEORY AND PRACTICE
Chapter XIII
Robert A. Clark, Jr.

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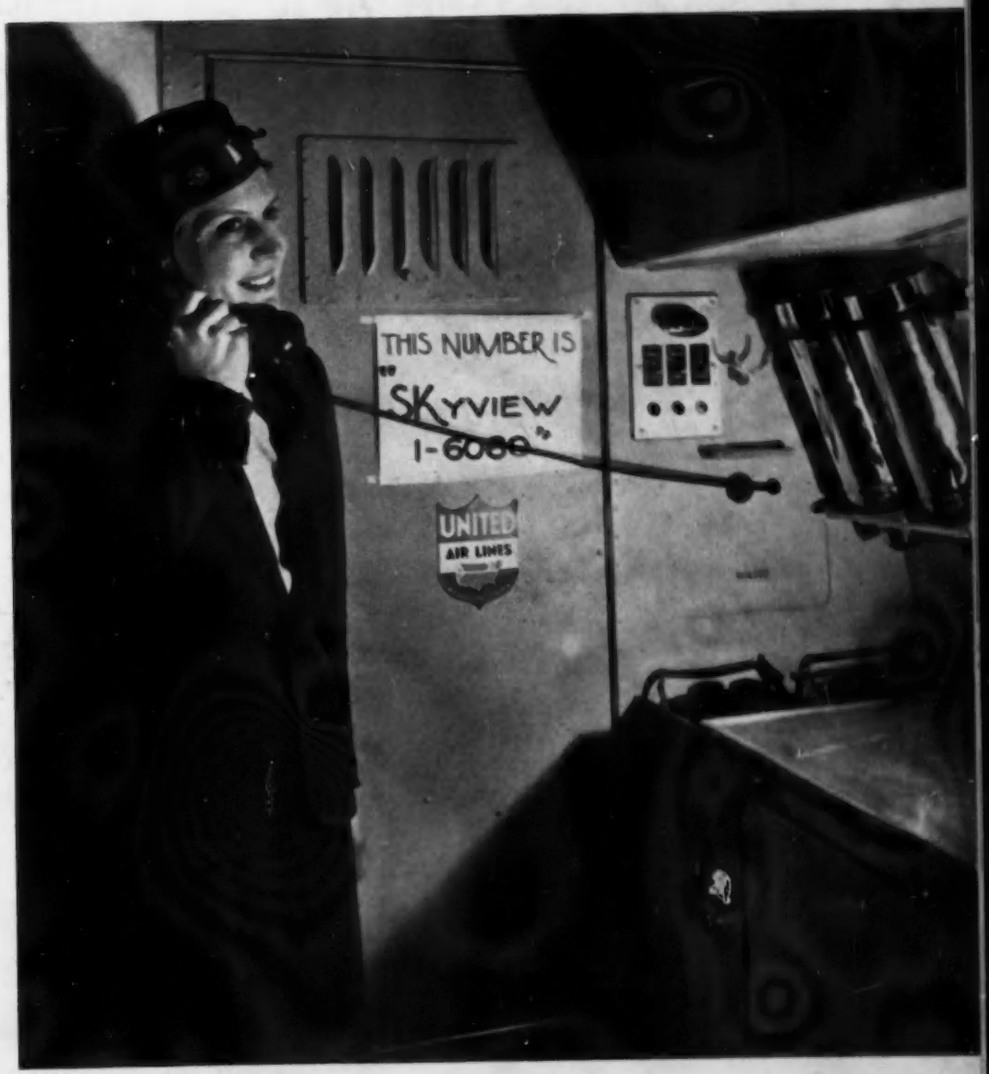
SWITCHBOARD MAINTENANCE
Part VIII
C. K. Brown



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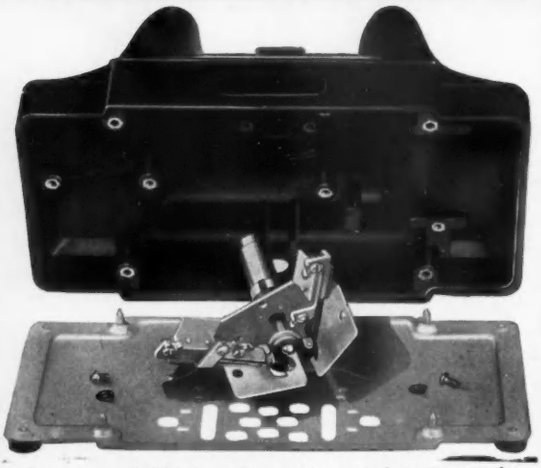

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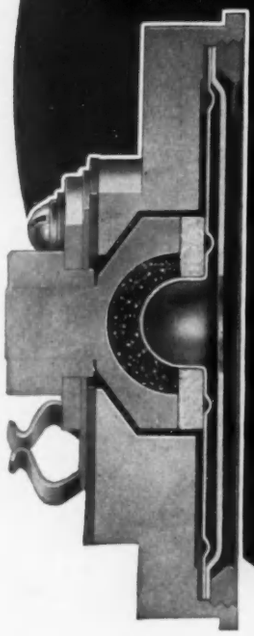

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17. ***TRIAD*** CIRCUIT WHICH ELIMIN TONE AND DISTORTION WITHOUT CING VOLUME.

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TELEPHONE ENGINEER
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FEBRUARY, 1937

"Tapping In" On Washington

By ROLAND C. DAVIES
Editor
Telecommunications Reports

Court Test of FCC Jurisdiction Over Independents . . .

● The first court test of the FCC's jurisdictional powers over Independent telephone companies because of alleged Bell System control because of a Bell company's financial investment now looms as a most important event for the telephone industry to follow.

● With the denial by the Communications Commission of a rehearing before its en banc membership, the Rochester, N. Y., Telephone Corporation has disclosed it will challenge in the Federal Courts the ruling of its being under the control of the New York (Bell) Telephone Company. The Telephone Division had held that the Rochester Company, because of a 33 per cent common stock interest and a substantial preferred stock holding by the New York Telephone Co. was under its domination and control and therefore was a carrier fully subject to the Communications Act. The ruling was founded on the veto power of the New York Telephone Co. over certain phases of any new capitalizations or acquisitions of the Rochester Company—which had never been exercised by the Rochester Company. The Rochester Telephone Corporation is one of the largest Independent companies in the country.

● At the same time, the Telephone Division received a stiff onslaught from a small Independent, the Garrett, Ind., Telephone Co., which likewise had been adjudged a Bell-controlled carrier because of a 50 per cent stock interest of the Indiana Bell. The spokesman for the Garrett Company in an appeal argument before the Division cited that the Independent greatly outnumbered the Indiana Bell directors on its board with local directors and that there had never been any attempt at dictation of policies or any controversy over the company's operations. He charged that the Telephone Division finding was based upon "inferences" and not upon the facts of the case or the law. A number of hearings of Independent companies in which there is a stock interest of Bell companies are slated to be heard during the spring by the FCC examiners. Among these will be two Wisconsin Independents — Northwest and Barron County companies to be heard in late February at Milwaukee—and the Tri-County Telephone Co. of South Haven, Mich., to be heard at Detroit on March 2.

FCC Anxious to Get Complete Facts About Telephone Industry . . .

● Indication that the FCC is anxious to give the American Telephone and Telegraph Co. and Bell System fair treatment in its analysis of the facts brought out in the Telephone Investigation and wishes to guard inaccurate facts being included in the later reports to Congress was given by Telephone Division Chairman Paul A. Walker in a recent Investigation hearing. These views were expressed by Commissioner Walker at the Investigation hearing on Long Lines alleged excess plant in response to a renewed protest by counsel for the A. T. & T., about the methods of conducting the Investigation with only one-sided evidence. Commissioner Walker declared that the Commission would "give further consideration" to the request and may later make a statement or ruling.

The A. T. & T. counsel had pointed out that the telephone company had had no opportunity to develop the inaccuracies and defects in the Investigation exhibits and studies because there had been no chance for the A. T. & T. to cross-examine the FCC investigators and for the company to present its own evidence through its own witnesses. It was "obviously impossible" to deal with the bulky Investigation reports and testimony by written statements or explanations, the counsel stated.

● To undertake merely to correct misstatements, the counsel continued, by such a method of placing counterstatements in the record would not be a real opportunity for the A. T. & T. to present its case. The Investigation reports, placed in the record during the hearings of last Spring and December, had contained, it was claimed, a great deal in conclusions, argumentative matter

and the selection of certain facts, while even more significant facts were ignored and the results had been inaccurate, and unsound.

This method of investigation, the A. T. & T. counsel continued, is not a method that "is fair to the company or one that will result in a proper ascertainment of matters that are necessarily vastly important to the Bell System companies." In reply to a view of Commissioner Walker that the pressure of time and finances obviated much time for the presentation of all sides in the testimony, Mr. Price proposed that it might be appropriate to limit the scope of the inquiry so the matter covered would represent both sides. He added that it was an impossibility for the telephone company to point out inaccuracies in the bulky Investigation reports on a few days' notice as had been asked on several occasions. He cited that these reports represented the result of months of preparation by a large Investigation staff, and could not be adequately corrected in a mere brief statement of enumeration of inaccuracies.

● Chairman Walker emphasized that the Commission wanted to develop the facts and declared the company had the right to point out the errors and misstatements in the reports of the Investigation. However, he noted that the Investigation was not like a rate case involving deprivation of property so long-drawn-out cross-examination and presentation of testimony were not so essential. He pointed out that the Investigation did, of course, have the goal of laying a factual foundation for regulation and, when rate regulation comes along, the company would have ample opportunity for presentation of its case.

The Telephone Division Chairman said in regard to the FCC's report later to Congress that the reports being placed in the Investigation record were "reports of the staff which the Commission has employed in this investigation." Whether this may mean the FCC might take a different view in reports to Congress than the Investigation staff was not known. Such a speculation had arisen previously as it is understood several Commissioners had not been satisfied with the Character of the Investigation last Spring. Of course, it might also mean a change in methods later, if a report of the designation of Carl I. Wheat to be in legal charge of the Inquiry should materialize, as is expected in the near future.

● Chairman Walker declared in his comments on the company's protest that he did not mean there had been any misstatements of facts in the Investigation and that the Investigation staff members who have been witnesses have been qualified experts with training and knowledge of their subjects so their testimony should be given weight by the FCC. He noted that reports by the Investigation staff had been placed in the hands of the company prior to their presentation at the hearings so the company could correct them.

Appropriate $350,000 . . .

● The telephone regulation branch of the Federal Communications Commission is slated for a busy eighteen months through the approval by Congress and President Roosevelt of the additional $350,000 appropriation for the continuation of the Telephone Investigation. The added fund brings up the total allotment to the Telephone Investigation to $1,500,000.

● The Investigation hearings will be carried on until next July 1 and then a special rate and research department will be formed by the FCC to study the results of the Investigation for another year until June 30, 1938. The work of this special department will be highly important to the telephone industry because out of its labors will come the major reports and recommendations for additional regulatory legislation which the FCC will transmit to Congress and also will probably be evolved not only the Federal program for telephone regulation but perhaps a nationwide plan for the guidance of state commissions.

● In outlining the program of the Investigation, FCC Telephone Division Chairman Paul A. Walker told the Appropriations committee of the House of Representatives in his advocacy of the $350,000 added fund that the Investigation staff was preparing for presentation approximately 50 additional reports and studies about the Bell System and Western Electric Company which would be great value for future regulation. These Investigation studies range over a wide variety of subjects, such as the American Telephone and Telegraph Co. monopoly with its effect on rates and service and on patents; the segregation of interstate and intrastate plant, revenues and expenses and the relations of the Bell System with Independent companies; manufacturing costs of Western Electric; equipment installation costs' comparison between Western Electric and Independent manufacturing companies; depreciation procedure and program both of the Bell System and Long Lines; license contract costs with special emphasis on research and development and financial studies of the American Telephone and Telegraph Co. and Western Electric.

● Special stress is expected to be directed by the Investigation in its future hearings on the engineering probe of the telephone industry. Depreciation, manufacturing costs, and cost of research and development are believed to be slated for the "key" spots in the Investigation and most of the work of presenting the engineering subjects will devolve upon Cyrus G. Hill, Investigation chief engineer, who came to the FCC with a wide experience in the Bell System and Independent telephone fields.

● But overshadowing the program of subjects to be presented at the future hearings is the plan of the FCC to set up the special rate and research department. This unit is being urged by Telephone Division Chairman Walker as a regular and permanent branch of the Commission. The Commissioner told the House Appropriations Committee that such a department with an annual cost of $500,000 a year would be a worthwhile expenditure in the interest of strengthening telephone regulation. His aim is that such a force of experts could make a continuous examination of the telephone industry, rates, depreciation, manufacturing costs and even policies of the management side of the business so as to keep abreast of developments and furnish the FCC and to aid the state commissions in their tasks of regulation. One plan which has been suggested for a function of such a special unit would mean its use to form a mobile rate expert squadron to aid state commission which engages in a telephone rate regulation case. It is felt in FCC circles that such a mobile group of experts would be valuable in battling an array of telephone company expert witnesses in state commission proceedings. If such a permanent department should be set up in

(Please turn to page 27)

THE FRONT COVER

The nation's shortest telephone connection, a distance of thirty feet, is on the new luxury Mainliners now in service on the United Air Lines non-stop schedules between Chicago and New York. The 'phone connects the pilot's compartment and the stewardess' pantry. This phone in the clouds is SKyview 1-6060, the number being taken from the Department of Commerce numerals assigned to this particular Mainliner. Stewardess Hazel French is shown giving a message to the pilot over this miniature system.

Telephone Transmission
Theory and Practice

By ROBERT A. CLARK, JR.

CHAPTER XIII

Miscellaneous equipment used on long distance telephone circuits is described together with suggested testing and maintenance procedure.

● We have now covered the major items of equipment used in connection with long voice frequency telephone circuits. There remains, however, a few items which we might discuss briefly to complete the picture.

Where repeaters are used at intervals along a telephone line some means must be provided for passing the ringing signals. There are many cases especially those where only one repeater is required in which the ringing energy is sufficient to operate signals at the distant end if a means is provided to by-pass the ringing frequency energy around the repeater. Such a circuit is shown in Figure 64. You will note that the by-pass consists merely of a choke coil bridging the repeater on the line side and also on the line balancing networks. The bridging coils are of such inductance value that the impedance to the ringing frequency is small but comparatively high at the voice frequencies. The inductance of such a coil is approximately 2.5 henries.

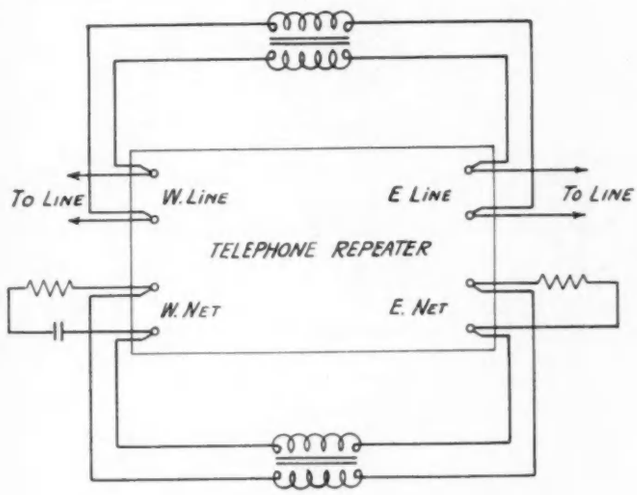


Fig. 64. Ring By-Pass for telephone repeater.

Where it is necessary to repeat the ringing signal a relay circuit such as shown in Figure 65 proves suitable. As you will observe from the figure there are four relays required. The principal of operation is as follows. Assume a ringing signal coming in on the east line, the east "A" relay closes applying battery to the east "B" relay. Operation of the east "B" relay applies ringing voltage to the west line; the power supply to the repeater is also interrupted

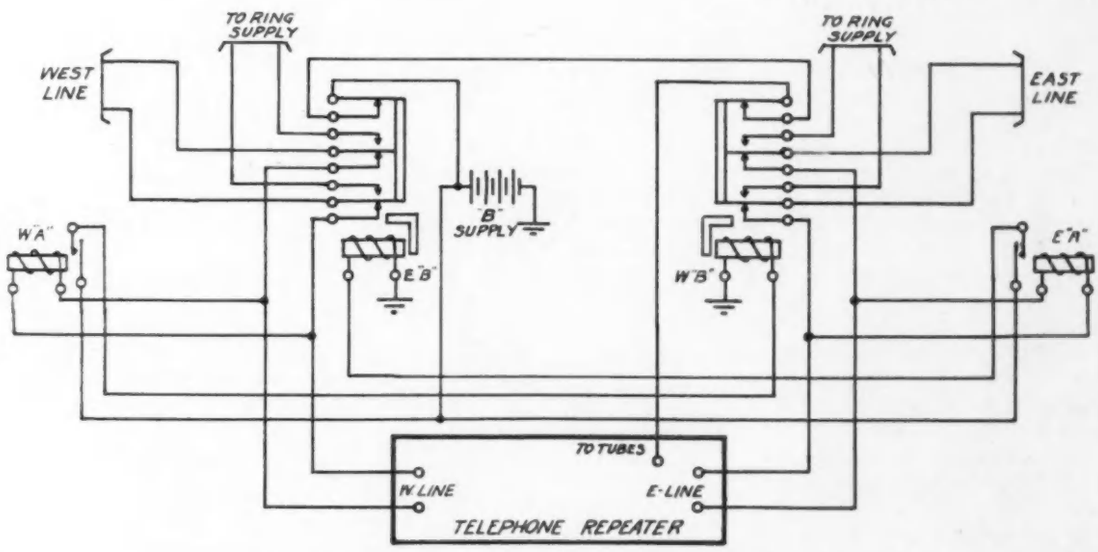


Fig. 65. Circuit of ringing repeater, also used for 133 cycle composite ringer set.

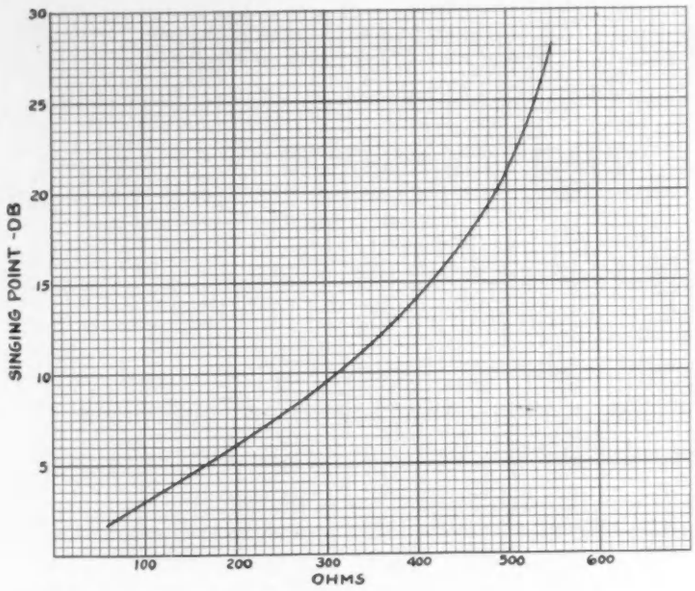


Fig. 67. Curve of singing point versus 600 ohms.

which prevents singing due to the unbalanced condition. As the "A" relay must be very sensitive the auxiliary "B" relay is used to switch the several circuits involved. A ringing signal on the west side operates the west "A" and "B" relays in a similar manner.

On composited telephone circuits (see Chapter IX Fig. 52) the ringing problem is somewhat more involved as the condensers in the composite set will not pass the low frequency ringing energy. Two systems have been developed for such circuits, one known as the 133 cycle composite ringer, the other, the 1,000 cycle ringer.

● The 133 cycle ringer is quite similar in principle to the 20 cycle ringing repeater shown in Fig. 65. Assume the line on the east side and the telephone exchange on the west side. A repeater if used may be located where the repeater is in Fig. 65, otherwise a repeating coil with condensers in each midpoint will be sufficient. The telephone ringing supply (west side) is 20 cycles, and the line ringing supply (east side) 133 cycles. The composite sets will pass the 133 cycle frequency with little attenuation and with ringing potential of about 75 volts open wire circuits up to about 200 miles may be operated without difficulty.

The "A" relay on the line (east) side is sensitive to 133 cycle frequency obtained by either mechanical or electrical tuning or a combination of both. You will readily follow the principles of operation, a 20 cycle ring on the drop side of the ringer sends 133 cycle ringing frequency out on to the line; likewise an incoming 133 cycle signal sends a 20 cycle ring to the exchange.

On long telephone circuits involving several repeaters the 1,000 cycle type ringer has some advantages over the 133 cycle composite ringer described above. Whereas it is necessary to install 133 cycle ringing equipment similar to that shown in Fig. 65 at each telephone repeater point no intermediate ringing equipment at all is required with the 1,000 cycle ringer as the signals pass through the telephone repeaters the same as the voice energy. In principle the circuit of the 1,000 cycle ringer is similar to that of Fig. 65 illustrating the 133 cycle ringer except that a 1,000 cycle source interrupted about 20 times per second is used instead of the 133 cycle frequency. The line relay (in our illustration the east "A" relay) is designed to respond only to the interrupted 1,000 cycle energy. This involves a rather involved system of tuned circuits and vacuum tubes which in this elementary discussion we need not concern ourselves. By designing the system to work on an interrupted 1,000 cycle tone the operation of the relay on voice signals is prevented. One who is skillful in whistling can learn to trip the receiving relay but it is quite a trick as both the pitch of the whistle as well as the warble must be correct within a small percentage.

● Before we discuss the problem of lining up and maintaining long telephone circuits we might well discuss the method of balancing telephone repeaters in somewhat more detail than covered in Chapter XI. As most of you know the difficult problem in operating telephone repeaters is that of maintaining adequate balance between the line and the network. Many attempts have been made to develop equipment which would not necessitate a high degree of balance. Recently, a new type of repeater has been developed which it is claimed can be operated with a considerably lower degree of balance than with the ordinary 22 type. This should be of material benefit in the cases where line balance cannot be maintained as for example, on train dispatching circuits where bridging telephones are located at frequent intervals along the line.

The degree of balance between the line and its balancing network is expressed by means of the singing point; this represents the transmission loss from one side of the hybrid coils to the other in the repeater shown in Fig. 58 (Chap. XI). Referring to this figure and considering the east line and network to be identical throughout the voice frequency band, the energy flow from the W-E tube through the CL-18-4 and CL-18-3 transformers to the E-W tube would be extremely small and the singing point therefore high, being determined only by the balance in the transformer. In practice, we find that the singing point under such conditions is at least 35 or 40 db. When the line does not balance the network there will be an energy flow from the W-E tube to the E-W tube, the magnitude of which depends on the degree of balance between the east line and the east net. This energy flow expressed in terms of transmission loss between the W-E and EW tubes is known as the **singing point.** In practice on telephone lines of the usual type this will range from zero to 25 or 30 db depending on the type of line and the precision of the network.

● If the line and network are pure resistance the singing point may be expressed by means of a simple formula. This is

$$\mathbf{S} = 20 \log \frac{\mathbf{Rl}}{\mathbf{Rn}} \qquad (36.)$$

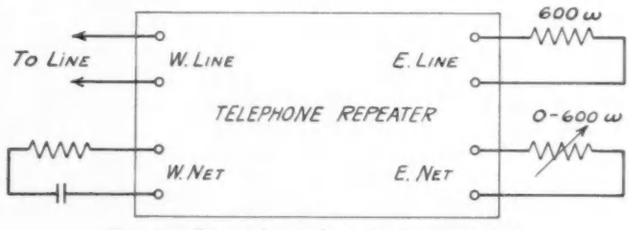


Fig. 66. Circuit for making singing point tests.

Where **S** is the singing point in db, **Rl** is the line resistance and **Rn** is the network resistance. This equation may be used with a fair degree of approximation in determining the singing point of a line by means of the impedance curves discussed in Chapter XII. In such cases we plot the line impedance curves on the same sheet with the network impedance curves and observe the point at which the unbalance between the line and network is greatest. From formula (36) we determine the singing point and also the frequency at which the repeater will sing.

The actual determination of singing points is made in a somewhat different manner however, which automatically takes into account all variations between the line and network impedance throughout the voice range. There are several methods of making singing point tests, however the most practical employs a fixed resistance of 600 ohms and a variable resistance ranging from zero to 600 ohms; the theory is shown in Fig. 66. Assume we are to measure the singing point between the west line and its network, we connect the 600 ohm resistance to the east line and the variable resistance to the east network as shown in Fig. 66. Under such conditions the singing point of the circuit is equal to the sum of the repeater gains in both directions at which the repeater starts to oscillate. Now we can determine the singing point between the 600 ohms and any value of adjustable resistance; Table 17 computed from formula (36) shows this relation, the data is also plotted on the curve shown in Fig. 67.

● The method of making a balance test consists of setting the two gain dials of the repeater at a known value generally 15 db each. The resistance is then varied until the repeater starts to sing. The value of this resistance is noted and the test repeated with the 600 ohms on the network side and the variable on the line side of the repeater.

REPEATER MAINTENANCE TESTS

Repeater Point Madison Circuit Chicago-St Paul

Date	East-West				West-East				Rect Tube Test	Remarks
	Step	Gain DB	Plate MA.	Tube Test	Step	Gain DB	Plate MA.	Tube Test		
8-1-36	4	9	6	127	4	9	6	130	134	CLR

Fig. 69. Form for recording telephone repeater tests.

Generally the resistance value at which singing commences will be slightly different under the two conditions. The largest value of resistance obtained in the two tests is used in determining the singing point. From the curve (Fig. 67) or Table 17 the singing point on the east side of the repeater is determined.

TABLE 17

SINGING POINT OF VARIABLE RESISTANCE VERSUS 600 OHMS

Singing Point	Ohms
Inf.	600
28	550
26	540
24	525
22	510
20	490
18	465
16	435
14	400
12	360
10	315
8	260
6	200
4	135
2	70

The singing point on the west side of the repeater is equal to the total gain to the repeater in both directions less the singing point of the two resistances. For example, assume the gains in each direction are 15 db giving a total of 30 db. Further assume the resistance at which the repeater sings is 200 ohms. From the curve we note that the singing point between the 200 ohm and the 600 ohm resistance is 6 db. Subtracting this value from the total gain of the repeater (30 db) leaves us 24 db as the singing point between the west line and its network. We determine the singing point between the east line and its network in the same manner as described above, placing the 600 ohm and the variable resistance on the west side.

The sum of the singing point of both lines should exceed the sum of the normal operating gains of the repeater by at least 10 db if more then one repeater is required on the circuit. If only one repeater is used the margin may be reduced to about 6 db although in some cases this is not sufficient especially where there are bridging way stations. On smooth lines singing points of from 20 to 25 db can readily be obtained. However, if there is appreciable non-loaded cable in the circuit the singing point will be much lower sometimes not greater than 6 to 10 db. This obviously does not permit very high gains on the repeater. As the over-all singing point of the repeater is equal to the sum of the singing points of each line it is possible to obtain fairly high gains if only one line has a high balance. For example, on a circuit with one repeater

(Please turn to page 31)

TRANSMISSION MAINTENANCE TESTS

Tests at 1000 Cycles Unless Noted. Circuit Chgo - St Paul

Date	Direction	E Term Level DB	Line Loss DB	Repeater Madison				Line Loss DB	Repeater La K				Line Loss DB	W Term Level	Circuit Equiv. DB	Remarks
				East Level DB	Gain Step	Gain DB	West Level DB		East Level DB	Gain Step	Gain DB	West Level DB				
8-1-36	E-W	0	8	-8	5	10	+2	12	-10	4	9	-1	9	-10	10	Clear 40° CLR.
	W-E	-10	8	-2	5	10	-12	12	0	4	9	-9	9	0	10	

Fig. 68. Form for transmission maintenance record of long telephone circuits.

P.B.X. Switchboard Maintenance

By C. K. BROWN

PART VIII

Locating common faults developing in P.B.X. equipment are of prime importance in keeping maintenance cost to low levels. Ingenious and simple antidotes for these ills are discussed in this, the eighth of a series.

● Many very common faults which develop in the equipment of a P. B. X. switchboard are: (1) Cross talk. (2) Key, jack, and relay trouble. (3) Noisy cords. (4) Station trunk, and supervisory signal trouble. (5) Trunk or station circuit noisy. (6) Can't get the P. B. X. switchboard operator on a trunk or station circuit. (7) Can't hear on the trunk, and etc.

In order to locate certain of these faults all that is required is an ordinary head receiver and the circuit diagram of the equipment, plus an analysis of the trouble. For example, suppose the report to be "Central cannot get the P. B. X. operator". The Case is analyzed as follows: (1) Nature of fault, that is the operator fails to receive the call. (2) Symptoms. The outstanding symptoms are, trunk relay operation failed, failure of the visual or audible signal to function. (3) Probable cause of the trouble, which may be due to one or more causes, such as open trunk circuit, trunk relay out of adjustment, signal lamp burnt out, operator not at the board, battery supply failure, and etc.

The next step is to follow up whatever conclusion arrived at, as for instance, suppose it is decided to test for the fault, then refer to the trunk circuit diagram and study that part of the circuit involved. For example, consider the diagram shown in figure one in which only that portion of the trunk circuit in which the fault may be located is given.

● Before describing a method of testing for the trouble a description of the circuit will aid in conducting the tests. The two trunk conductors from the central office are connected through the P. B. X. switchboard cable to a connecting panel in the rear of the switchboard and thence to the "night jack" springs. From the night jack springs the circuit passes through the dial key to two condensers which are in series with each side of the trunk circuit, through the contact springs of relay No. 1, and then terminated at the regular trunk jack springs.

To localize the fault, first remove the cover from trunk relay No. 2 and manually operate the relay armature. If the trunk lamp does not light, the trouble is in the lamp circuit, and is caused probably by an open fuse, burnt out lamp, or poor contact at the relay, etc. If the lamp lights the fault is in the trunk circuit. To test, ring on the circuit from the night jack.

● If the central office operator responds, the trouble is between this point and the winding of relay No. 2. Now connect short lengths of lamp cord with clips attached to the terminals of the condensers designated "T and R" in the trunk circuit, and the insert one of the switchboard cord plugs into the trunk night jack, this will allow the cord battery to flow through the winding of relay No. 2, if the relay is properly adjusted it will operate and light the trunk lamp, thus verifying that the relay is O. K. and that the fault may be due to one of the condensers being open. In the final analysis all that may be needed to clear the actual trouble will be either a heated soldering copper to resolder a loose connection or a relay contact burnisher.

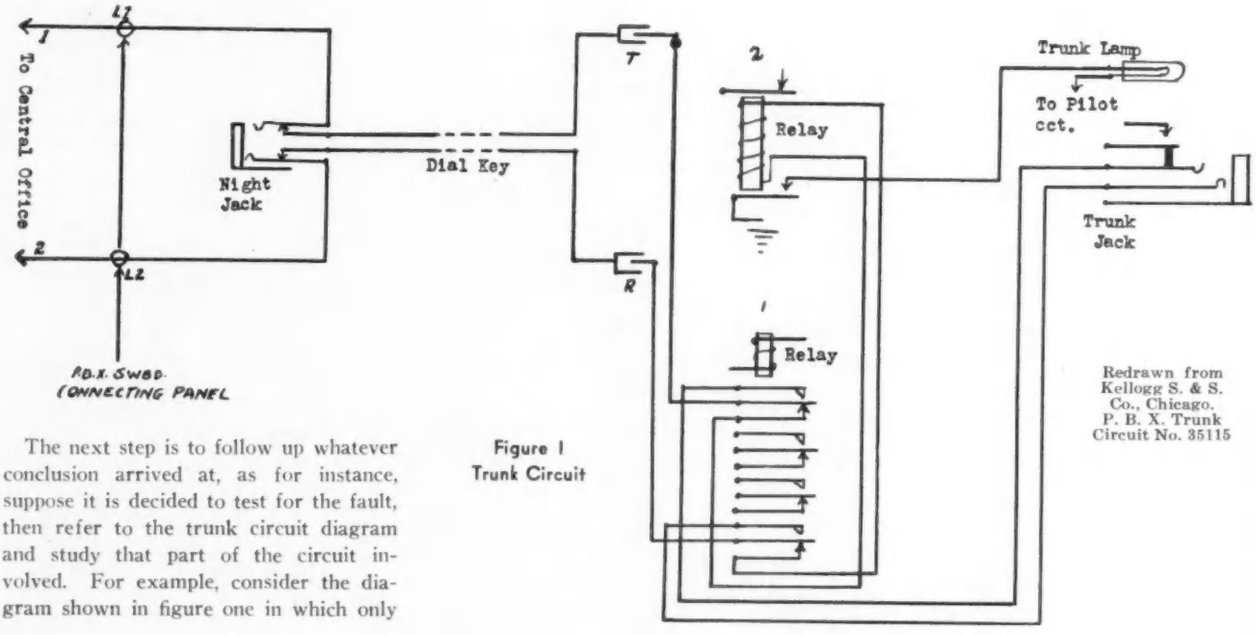


Figure 1
Trunk Circuit

Redrawn from Kellogg S. & S. Co., Chicago. P. B. X. Trunk Circuit No. 35115

In the case of a noisy switchboard, if the noise is of a steady humming sound it may be assumed that it is caused by induction or earth currents. The principal source of earth disturbance, is a grounded P. B. X. battery supply, the only satisfactory remedy for which is to install a complete metallic battery supply either from the central office or by means of a local storage battery located at the P. B. X.

● In addition to this, other noises on a P. B. X. are due to loose connections in the battery supply leads, open battery or ground lead, loose connections in a trunk or station circuit, or defects in the P. B. X. operators telephone circuit, or in the switchboard cords.

P. B. X. operators often have the habit of using certain cords on the switchboard much more than the others, if one of these cords become noisy, the operator usually attributes the noise to other causes. A simple cord test, such as connecting the clips of a cord attached to a test receiver across the tip and ring of the switchboard cord plug and shaking the cord. A scratchy or cut out sound will be heard if the cord is at fault.

If the noise is in the operator's telephone circuit it can be determined by listening on any station circuit with the operator's receiver and with a cord circuit listening key open, at the same time shaking the operator's receiver cord, if the trouble is in the cord a scratching or cut out sound will be heard. Repeat the test with the operator's transmitter cords. If the transmitter cords are noisy, or a loose connection exists, it will be manifested by a noise in the operator's receiver. Short circuit the transmitter, and if the noise disappears, then the trouble is in the transmitter, due possibly to a loose connection, faulty carbon, etc. Inspect the cord connections, and if required make necessary corrections, or if the transmitter is at fault it should be replaced.

A noisy operator's receiver will be indicated by connecting a test receiver across the operator's receiver cord terminals at the same time listening in the test receiver with a cord circuit listening key open, if the trouble is in the operator's receiver it will not be heard in the test set.

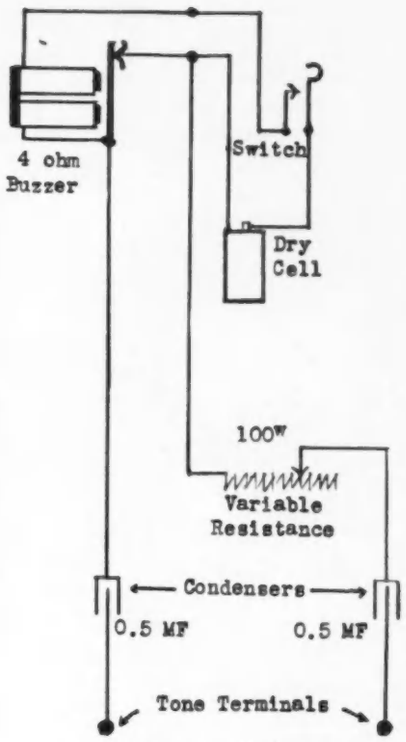


Figure 2. Tone test for locating cross talk and other faults.

A loose connection at the switchboard induction coil, or a retardation coil, will also cause noise on a P. B. X. switchboard and this can be located by inspection.

● Cross talk on a P. B. X. switchboard can exist between station line circuits, or it may be in the key or cords on a position, or it might exist in the form connecting the cords with keys relays, condensers, or repeating coils. In attempting to locate this fault, it should be remembered that there is a difference between cross talk caused by induction, and that caused by direct physical contact between the conductors of two circuits. In the first case the trouble is generally due to an unbalanced condition in the circuit, probably due to not using twisted pair wire in the transmission path, and in the second instance, the trouble may be due to dampness, grounds, or poor insulation on the wiring or apparatus.

P. B. X. switchboard keys that have been in service a long time collect dust or dirt and if not regularly removed will accumulate between the key springs and bushings and thereby lower the insulation resistance between the cord circuits, thus causing cross talk, the same condition if allowed to exist at the relays, repeating coils, fuse panel, or at the cable terminal panel in the rear of the position will also cause cross talk.

When a P. B. X. switchboard is first installed, it occasionally happens that the cable conductors are improperly terminated either at the switchboard connecting panel or at the cable terminal. Thus, the mate of one cable pair will be connected as the mate of another pair and will cause an inductive cross, that is, causing cross talk between the two circuits by induction, and is known as a split pair.

● To test for cross talk between two cords, connect the tip and ring of the cord on which cross talk is heard to a tone, such as produced by an ordinary buzzer as shown in figure 2, and then connect the clips of a cord attached to a test receiver across the tip and ring of each other cord pair plugs on the position one at a time. If the tone is heard on any cord, that cord is crossed with the cord under test. To determine if the cross is inductive or caused by direct contact disconnect the tone and connect one terminal of several dry cells together in series to both the tip and ring of the cord on which the cross is heard. Remove the battery fuse from both of the cords being tested, and with one of the test receiver cord clips connected to the other terminal of the dry cell battery, touch the other test clip to the tip and then the ring of the other switch-

(Please turn to page 22)

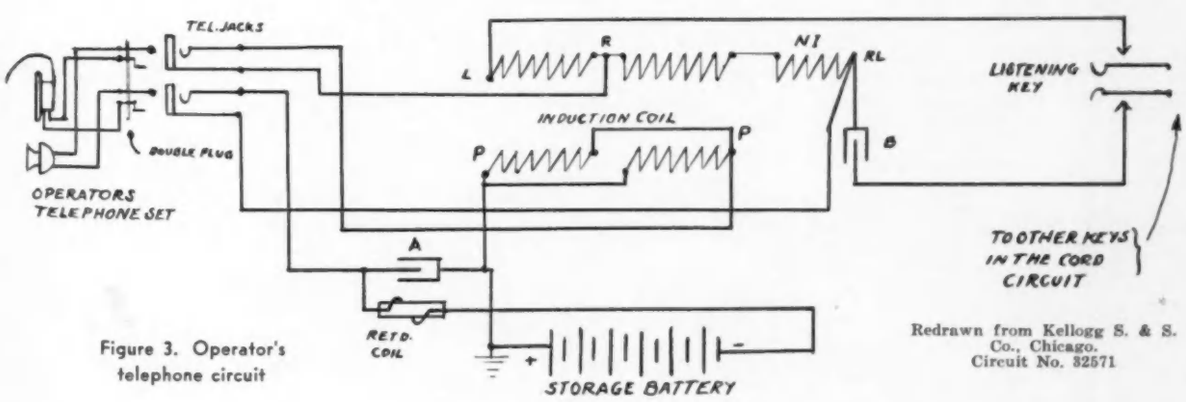


Figure 3. Operator's telephone circuit

Redrawn from Kellogg S. & S. Co., Chicago. Circuit No. 32571

One line story—pristine glory—telephone worry.

Dick Etzkorn, Portsmouth, Ohio, at his raised testboard snapped at 4 a.m. by Frank Sabine.

This scene was enacted in many towns in the flood area. Water taxis operated by plant men.

A giant "skip-the-rope" was the ludicrous result of high water in Ironton, Ind. Receding waters left this house resting on exchange cable.

"OLD MAN RIVER" and "OLD MAN WINTER"

Just Keep Tear'n 'em Down!

These views of the recent flood damage and disastrous sleet storms suffered by the industry tell their own story. An "Act of God" from which there is no appeal. Stories of heroism by telephone men and women who did yeoman service during January combating Mother Nature will be retold for many years. Telephone companies were probably the first to recover their equilibrium as events of this nature are all in the days work for them. Damage is already counted in the millions.

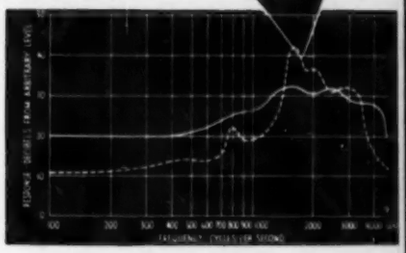
PROOF →

THAT THE TYPE 35A7 TRANSMITTER OFFERS--

The artificial "mouth and ear," used by Automatic Electric engineers to measure comparative transmitter responses with scientific accuracy.

1. Higher, More Uniform Response Throughout Voice Frequency Range.

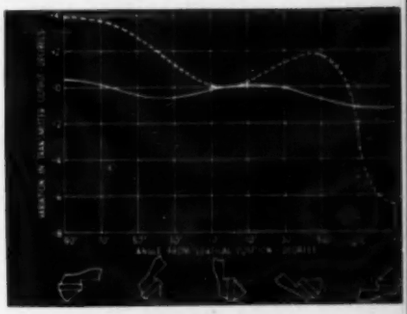
   The most up-to-date laboratory device for accurately testing acoustic response is the mechanical "mouth and ear" shown at the right. Using this device, supplemented by exhaustive "talk and listen" tests, our research engineers plotted comparative curves covering every phase of transmitter performance, some of which are shown here. The first one indicates the higher, more uniform response of the new Type 35A7 transmitter throughout the entire voice frequency range.



The solid line shows the higher, more uniform response of the 35A7 transmitter, as compared with that of the previous Monophone transmitter.

2. Uniform Output Regardless of Position Held.

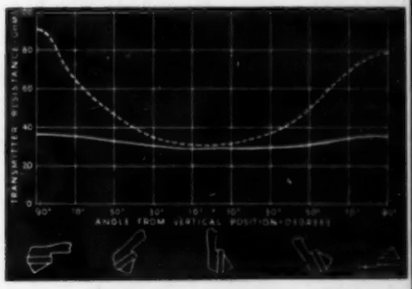
   The second curve shows the almost constant output of the new transmitter, regardless of the position in which it is held. This remarkably small variation throughout the complete cycle of positions, proves that the Type 35A7 transmitter has true "all positions" performance.



The solid line in this graph shows the almost constant output of the new transmitter throughout the complete cycle of positions.

3. Greater Stability With No Sacrifice of Volume.

   Curve No. 3 compares the resistance of the new and the old transmitters, showing how the resistance of the new transmitter remains uniformly low throughout the "all positions" cycle, insuring stability of performance with no sacrifice of volume due to extreme variations in resistance.



These curves show the comparative resistance of the new and old transmitters (solid and dotted lines respectively) throughout the "all position" cycle.

4. Unaffected by Humidity, Temperature or Pressure.

   Other tests made on this transmitter indicate that its unusual responsiveness is unaffected by changes in humidity, temperature or pressure, but that it retains its high efficiency regardless of external conditions.

5. Longer Service Life Without Deterioration.

   Life tests made on the Type 35A7 "all positions" transmitter show its useful life to be far in excess of that of the older types, with deterioration in performance much less rapid during this useful period.

Now being supplied as standard equipment on all Monophones, the new Type 35A7 transmitter is interchangeable with transmitters of all existing Monophones. Send for prices and full details.

AUTOMATIC ELECTRIC

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Switchboard Maintenance

(Continued from page 17)

board cord. If a click is heard in the test receiver, the cross is due to direct contact, if not the cross is inductive. By applying the same test to the various parts of any two crossed circuits it can be determined just where the cross is located, but the circuits during the test should be opened at each end.

● Crosses by direct contact, as a general rule, can often be located and cleared by making a visual inspection of the equipment, because many such crosses are caused by loose ends of wire, small pieces of solder lodged between keys or other apparatus, insulation worn from wires, dust accumulation or dampness. Cross talk between cord circuits may be caused by the shells or covers of repeating coils or relays touching other repeating coils or relays and is due to the insulation of the winding breaking down, and the wire touching the iron shell or cover. This trouble can be remedied by replacing the defective apparatus.

Consider a report of, "operator gets loud click in ear". Figure 3 shows an operator's telephone circuit connected by two conductors to the outer spring contacts of a cord circuit listening key, and is bridged, from this point to similar contacts on each listening on the position. One of the conductors from the key is connected to terminal "L" of the induction coil in the operator's telephone circuits, and the other conductor is connected to one terminal of a condenser, the other terminal of the condenser being connected to terminal "R L" of the induction coil, and from this point to the sleeve of one of the operator's telephone jacks. The sleeve of the other jack is connected to terminal "R" of the induction coil. In this circuit the operator's receiver when the telephone set plug is inserted in the jack is connected in multiple with one-half of the secondary winding of the induction coil and the non-inductive resistance. This arrangement produces what is known as a side tone reducing circuit. The principle upon which this operates is to the effect that any noise or disturbance in the circuit, or on the line to which the operator's telephone may be connected, will be equalized between the two sides of the circuit, and very little or none will pass through the operator's receiver; it being balanced between the center of the induction coil and either side of the line. While this is perhaps true in theory, it is not exactly true in practice, because a noisy line will always be heard in the operator's receiver to a greater or less degree, but the noise will not be as pronounced as if the receiver were connected directly to the line circuit.

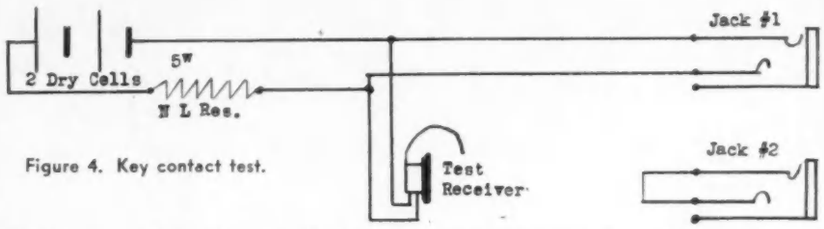


Figure 4. Key contact test.

● If one or both of the cord circuit listening key springs break contact, after the listening key is connected across the circuit, the operator will get a click in her receiver, and an intermittant break, or loose connection, in any part of the operator's telephone primary or secondary circuit will cause the same trouble, with this exception, that if the trouble is in the secondary, it will only be noticed when the operator's circuit is connected across a line. When the operator connects her telephone set to one of the cord circuits, the condenser "B" in the receiver circuit is charged by the battery from the cord circuit. If any other listening key on the position should happen to be short circuited, and the defective key is used, the condenser will discharge itself through the short circuit, thus producing a click in the operator's receiver.

A frequent source of noise trouble is found in the cords connected to the operator's telephone set, a cross between the receiver and transmitter cords will cause a click in the operator's receiver when the operator opens a listening key. Certain types of P. B. X. switchboard operator's telephone circuits are equipped with a click reducing device bridged directly across the operator's receiver circuit. This device consists of two small copper oxide discs and operates as follows: during an ordinary conversation the oxide discs have a high resistance and thus does not introduce an appreciable transmission loss. However, if a high electromotive force is produced capable of causing a loud click in the operator's receiver, the oxide unit changes momentarily to a relatively low resistance and in so doing practically short circuits the receiver at that time. Thus, all clicks are reduced to a point where they are not objectionable to the operator.

● Suppose the trouble report is, "operator cannot hear or be heard". The weak points of an operator's telephone circuit are the cords connected to the operator's set, the spring contacts on the listening keys, and the telephone set jack located on the switchboard position key shelf lock rail. Faults are occasionally found in other parts of the circuit, but the parts referred to above are subject to the greatest wear and tear, and of course the first to break down. The operator's set can be checked for being at fault by removing it from the jack and plugging in a substitute set, if this set talks up O. K. the regular set is defective. If the substitute telephone set does not talk up, it is indicative of the trouble being in the telephone circuit.

To test for the trouble, first remove the operator's telephone set from the jack and then connect one cord clip of a test receiver to the grounded side of the P. B. X. battery, then touch the other test clip to the ends of the retardation coil located in the operators' telephone circuit, if at each end a click is heard in the test receiver, the fuse and battery is O. K. to this point.

Next connect the cord clip of the test receiver directly across the tip springs of the operator's telephone set jack, if no click is heard in the test receiver, the fault either is in the connections to the jack, or the primary winding of the induction coil is open, or perhaps the condenser "A" is open or short circuited.

(Please turn to page 29)

Select J. H. Agee

As we go to press, we are informed that J. H. Agee, first vice-president of the United States Independent Telephone Association, has been selected as president by action of the board of directors of the association meeting in Chicago, February 15th.

This action of the board will meet the approval of the entire industry as Mr. Agee is well known both through personal acquaintance and through the columns of TELEPHONE ENGINEER. The new president is well known as a writer, one of his articles being included in our January issue. Although he will continue to serve the Lincoln (Nebr.) Tel. & Tel. Co., the directorate feels very proud to have him as their president. The association has not selected an active executive as yet and have announced that each year a new president will be selected to head the association with a paid executive in the association offices devoting full time to the organization.

May we congratulate the directors on their choice and Mr. Agee on his selection to the honor of heading the national association.

Value-of-the-service Factor in Utility Rate Making

By GEORGE J. EBERLE
Eberle Economic Service, Ltd.
Los Angeles, California

PART II — Continued

In the previous articles the author discusses various concepts of value of service and their application in rate cases. In the present article the author continues his analysis and reaches the conclusion that value of the service is a potent force in pricing utility services, but that vigorous and exacting research and study are required to develop its potentialities and fullest usefulness. Reprinted through courtesy of PUBLIC UTILITIES FORTNIGHTLY.

To help promising manufacturing enterprises through their early competitive difficulties would certainly appear to be good business. Officials representing governmental units, such as states, counties, and cities, have repeatedly offered inducements, with good results, to prospective industries. *Quasi* public enterprises may likewise promote the general welfare by liberal application of the ability-to-pay theory which will later redound to their own benefit directly by increasing, for instance, the saturation of their lines, improving their load, and expanding classes of remunerative service.

● In a recent case a city sought to condemn the property of an electric utility in a small compact profitable area, and leave to the utility the unprofitable rural area. This involved questions of discrimination, economic interdependence, and the spread of rates which came directly to issue.[12] The urban business and domestic income are largely derived from the income of the surrounding agricultural territory.

The indirect benefit to the urban consumers, paying more than cost rates, may be greater than the direct benefits from the service. The whole value of service theory is therefore composed of direct and indirect benefits and should be so considered.

In an electrical utility the pricing of services recognizes differentials between residence consumers, business consumers, industrial consumers, irrigation consumers, municipal consumers, etc. The demands of these various services upon the capacity of the plant either during the peak load, or during off-peak hours, the diversity factor, the relation of the active load to the connective load, the load factor, the stage of economic development, competitive and other factors, all influence the various levels of rates. In the operation of the Southern California Edison Company the summer irrigation pumping load is a welcome offset to the usual winter peak. Potentially idle generating, transmission, and substation capacity is therefore utilized.

● The cost of electricity to the farmer in irrigated areas sometimes is an important part of the total cost of crop production. If rates for electricity used for pumping purposes were placed upon the full cost of the service basis, including an arbitrary apportionment of all fixed charges, the farmer located in areas with low water levels would probably have difficulty in maintaining his position in the competitive market. Particularly is this true when it is taken into account that the saturation of electrical consumers in rural districts is low, and from this standpoint the cost of service is high. The value of service to the farmer in the case cited is relatively much lower than to the urban dweller. The latter is engaged in individual consumption, while the former largely takes service for further production supplying a very competitive field.

Thus, we often have this situation in practical electric rate making: In compact urban areas where the cost is comparatively low and the value of service is high, rates are high, above total cost, whereas in the rural areas where cost is high but value of service is low, the rates are low, below total cost. Value of service, both direct and indirect, is the controlling factor here, not total class of service cost.

● Another case in point is that even total cost of service by exchanges is not controlling in making telephone rates in a large area. This is disclosed by the data filed by commission witnesses in one case. Since no decision has as yet been issued the specific reference should be omitted. The summary income accounts include 80 exchanges. The 79 exchanges outside of the metropolis (with over a million population) represent practically every sized exchange up to about 36,000 stations. The exchange income accounts for the year ending June 30, 1934, were presented upon four bases; namely, revenues and expenses separated for toll and exchange upon a board-to-board basis and an allowance of 5 per cent sinking-fund depreciation; toll and exchange revenues and expenses segregated upon a station-to-station basis and 5 per cent sinking-fund depreciation allowance; a flat payment of 20 per cent of gross toll revenues to the exchanges and 5 per cent sinking-fund depreciation; and a flat 20 per cent allowance of gross

[12] Tulare v. Southern California Edison Co. (1933) 38 Cal. R. C. R. 849.

toll revenue to the exchanges and straight-line depreciation. For the latter two bases expense apportionments were less inclusive.

● The total rate of return for the entire exchange and toll system is 6.5 per cent. Upon a board-to-board basis and 5 per cent sinking-fund depreciation the toll system earned a return of 8.1 per cent; the metropolitan exchange a return of 8.5 per cent, while the balance of 79 exchanges, mainly outside of the metropolitan area involving approximately $40,000,000 of rate base, disclosed a 0.6 per cent return, and 68 exchanges had deficits. In a number of these exchanges the deficits range from 10 to 60 per cent of the rate base. The remaining 11 exchanges produced a return ranging from 0.1 to 3.0 per cent of the rate base. Only 4 of the exchanges have a return above 1.0 per cent.

● Some of these exchanges with a return of less than 3 per cent have plants involving a rate base of from $2,800,000 to $8,400,000. Some of the larger cities served range in population from 30,000 to 150,000. The other income account bases disclosed similar results.

Thus of the 79 exchanges with a combined rate base of upwards of $40,000,000, not one had returns which met the total cost of service on any conceivably fair basis. About 50 exchanges are entirely outside of the metropolitan area and thus have slight claim, if any, from the standpoint of interdependence upon the surpluses created in this large exchange. In telephone parlance a number of the smaller exchanges may be termed "toll feeders." That the earnings of the toll system, however, should offset the large deficits of most of the outside exchanges is open to question.

In some of the exchanges the full cost of service is not applied to rates because there is no present adequate consumer income, or stability, but rather because the low exchange rate levels have been fixed formerly upon a developmental basis or upon an historical value of the service and ability to pay consideration. It is probably a more or less frozen condition dominated by the latter two factors, and total cost of service in the outside exchanges has been relegated to a secondary position. Some of the exchange rate levels have been in force a considerable time and have established difficult precedents to break. Some revision in rates certainly would be justifiable, especially increases in exchange rates where the cost principle is so grossly violated, and where other favorable considerations are unduly prominent.[13]

It appears that in this important serving area value of service and ability to pay reign supreme in fixing exchange telephone rates outside of the metropolis, but total cost of service is controlling for the whole system.

PART III

● Many commission decisions reflect confused thinking upon the differences and relationships between cost of service, value of service, and ability to pay. A few will be cited to disclose some of the misinterpretations and misapplications which have been made of these fundamental concepts.

In a decision involving a reduction of electric rates the regulatory body made the following statement bearing upon the basis for determining the reasonableness of the existing rates which it said must be judged by the value of the service rendered and not by the profits of the company:[14]

> . . . the only way by which the value of the service can be ascertained in a case of this kind is by examining the company's records, its capital account and income, and all elements that should be considered in establishing a proper rate base upon which the company is to be allowed to base its earnings.

This infers that cost of service is a determinant of value of service. How can cost to the producer, for instance, measure the value of electric service to the individual consumer?

The value of service to the individual is dependent upon the comparative satisfactions derived, while the cost per unit is determined by the operating expenses, fixed charges, and return required to produce the service. If cost measures this value then the price, or rates, would always tend to be equal to cost, assuming that ability and willingness to pay do not interfere. But this is not true.

The prices or rates paid for a particular service, or for whole schedules of service, as shown, are often above or below the actual cost, and if a service is consumed for a considerable time the price paid is always less than the value of the service, otherwise ultimately there would be no purchases. The consumer demands a margin in value received over and above the price paid or cost to him.

● That value of service is measured by cost to the company was held by the Connecticut commission in 1934 in the Ansonia Water Case cited and is subject to the same criticism as the foregoing quotation. The commission said "clearly the value of the service is the cost to the company, honestly and economically managed, . . ."[15]

(TO BE CONTINUED)

[13]In making these criticisms it is assumed that the apportionment of general expenses and fixed charges to the toll and exchange systems is equitable; if not, a revision probably would not materially invalidate the criticisms.

[14]New Brunswick Board of Commissioners of Public Utilities, City of Moncton v. Moncton Tramways, Electricity & Gas Co. Ltd. P.U.R.1932B, 368,, 373.

[15]Docket No. 5973, July 10, 1934.

Line and Desk

RAY BLAIN, Member A.I.E.E., Editor

Q. Our toll and rural lines pick-up considerable current by induction and causes noise on our local telephones. Our local, rural and toll lines enter the exchange through the same cable. Please advise whether there is a method whereby this current may be passed to the ground at the cable terminal?

A. Yours is the ever increasing problem of telephone men. It is most difficult to suggest a remedy without knowing more of the local details. We assume that your rural lines are grounded and if such is the case we suggest that these lines be connected metallic through the cable and coupled to the grounded section of the line at the cable terminal by a repeating coil. Usually the inductive disturbances from high tension lines are in the form of a static earth seeking current. If the currents are metallic, a drainage coil may be connected across the line with the center tap grounded to drain the static current over both sides of the line to the center of the coil, thus neutralizing any disturbance on the line. Good drainage coils may be purchased from almost any telephone supply house. A weatherproof case may be obtained for mounting these coils at the cable terminal.

Q. What simple though satisfactory means may be employed in polishing switchboard plugs on a small system?

A. One satisfactory method is to use a piece of clean cotton tape about two feet long. Anchor one end to the key shelf and hold the other in one hand. Place a small quantity of approved plug polishing paste on the tape and make a hitch around the plug to be cleaned. Hold the tape fairly tight and push the plug back and forth. Care must be exercised not to hold the tape too tight or the end of the plug may be unscrewed.

Q. What purpose does a back board serve in the mounting of a telephone on the average wall?

A. Some companies require that a back board be used when mounting an iron box telephone or bell box on any wall not constructed of wood. The back board may easily be mounted on a plaster wall as the screws may all be located in lath which is almost impossible with the evenly spaced screws in the telephone set. The back board is also most useful on damp walls, or tile or other walls of such nature that toggle bolts must be used in mounting a telephone.

Q. Do ground wires on poles at certain intervals in a line serve any useful purpose?

A. Lightning discharges striking a pole line may destroy a part of the poles due to the charges reaching the ground through the poles. In this case the pole is generally split and shattered. This is no doubt caused by the sudden expansion of vapor gases created by the passage of the electrical current through the pole. Ground wires placed on about every 10th pole and not fewer than 4 per mile, are a most effective protection against damage caused from lightning discharge. Ground wires are also valuable in producing a silent discharge path from an electrically overstressed cloud, and tends to protect the poles and line from lightning discharges. However, they are not of value in relieving the line of oscillations of an electromagnetic nature.

Q. What is meant by "B" type main frame protection?

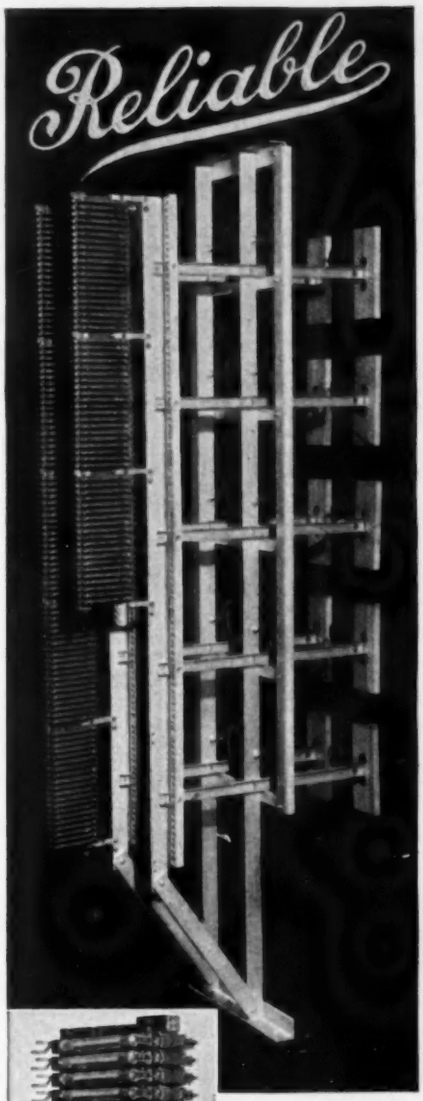
A. With this type protection the switchboard cable is terminated on terminal blocks and the outside cable pairs on the protector strips. The outside conductors terminate on the open space cut-outs side of the protectors and the jumpers, which cross connect to the switchboard blocks, terminate on the heat coil side of the protectors.

Q. When the cable has all been used from a reel should the lagging be nailed back on the empty reel?

A. It is considered a better practice to bind the lags in bundles of about 10 each. These bundles should be marked so that it will not be difficult to associate the lagging with the proper reel. Nailing lags back on empty reels shortens the life of both the reel and the lagging.

Q. What is the greatest length of 22 ga., 100-pair cable which can be obtained on a single reel?

A. This size cable generally comes in about 2500 feet to a full reel. No doubt a greater length could be obtained on special order. It is believed, however, that it would be unsafe to attempt to install a greater length of this size cable.



The simplified design of the protectors gives the highest degree of protection at a low cost per pair.

The heat coil and all moving parts are enclosed in the fuse-like cartridge, free from dust and accidental opening.

MODERN CENTRAL OFFICE PROTECTION

A complete line of standard frames for floor or wall mounting. See our latest catalog for further information or write to us for MDF bulletin.

Reliable ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES
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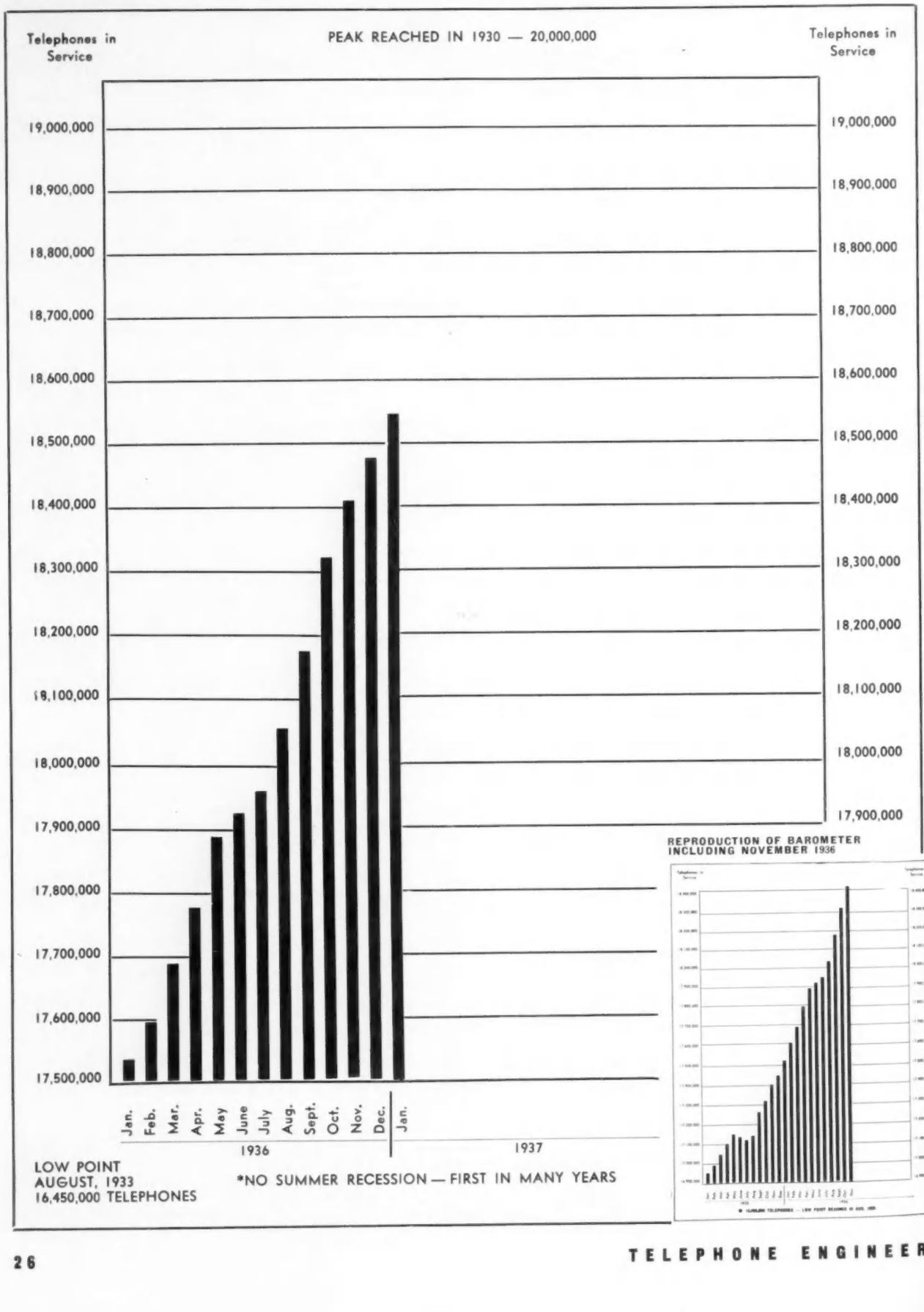
Monthly Telephone Station Barometer



WASHINGTON . . .

(Continued from page 12)

the FCC with an appropriation in the vicinity of $500,000 annually, it is expected that the Federal Commission would establish regional offices throughout the United States on a similar basis as now exists in the Interstate Commerce Commission.

● However, such a program rests in the laps of the gods in Washington as something to be watched at the session of Congress to convene in January, 1938. The Budget Bureau rejected the proposal when it approved the FCC regular appropriation for the next fiscal year which runs from July 1, 1937, to June 30, 1938. Whether such a plan ever would be established also depends upon the fate of the President's reorganization program, which would place the FCC administrative regulatory work under the aegis of a Cabinet department.

● In his statements before the House Appropriations committee, Commissioner Walker won considerable praise from the members of Congress, for the successful outcome of the FCC negotiations with the American Telephone and Telegraph Co. which culminated in the $12,000,000 annual reduction of interstate toll rates, effective last Jan. 15. The members of Congress also indicated keen interest in the disclosures by the FCC Investigation about the extra charges for handsets which had been imposed by Bell System companies in the various states. The handset charges' study of the Investigation has apparently created a wide interest among state commissions as a half-dozen or so regulatory bodies have already launched moves for the reduction of the charges and limitation of their duration.

● In his statements before the Congressional body, Commissioner Walker seemed to give inklings of what he thought the FCC ought to have in the way of increased regulatory power. He stressed that there should be full supervision over prices of telephone equipment. He cited that the Western Electric Co. dominated the telephone manufacturing field and that there was no actual Independent telephone manufacturing companies. Through a special and constantly functioning rate and research department, Commissioner Walker declared "we ought to be able to be kept advised about every company (Bell System) so that we could, after examining the books and after settling the question about telephone equipment prices or doing something about it and solving these other questions about these collateral issues like Bell Laboratories, license contracting

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and that sort of thing—we ought to have an organization that could tell at any time, without a special investigation, what the rate situation is, and whether rates can be reduced or whether they are adequate in all parts of the United States. And in addition to that we ought to be able to advise regarding policy."

Commissioner Walker also expounded his theory that if telephone rates were materially reduced the business of the companies would be materially increased. He declared that it was his belief the FCC could well function along that line and be able to advise the companies.

Telephone Investigation Hearings Cover Wide Variety of Subjects . . .

● The Telephone Investigation hearings during the latter part of January and early February delved into a wide variety of subjects—two Bell companies, the Southern and Southwestern, were probed as to their public relations and legislative activities with special emphasis on the furnishing of free telephone service to state commissions, state legislators and politically prominent lawyers who were retained through the granting of such service; the alleged high interest charges imposed on the Associated Companies for the "advances" by the American Telephone and Telegraph Co. and a charge that the Bell System had not lived up to the principles of the Hall memorandum regarding the purchase of Independent telephone properties.

● The activities of the Southwestern Bell Telephone Co. in regard to the 15-year-old controversy about the creation of a Texas state utilities commission and of the Southern Bell in connection with the employment of a South Carolina state senator in a telephone rate case, which the senator had supported at its outset, formed other highlights in the probing of those two companies. Investigation Special Counsel Samuel Becker followed his previous procedure of producing correspondence and memorandums from the files of the companies in an effort to show alleged improper practices to influence public opinion and legislation. But, in most cases, the alleged examples dated back a decade to twenty years ago.

● Investigation Chief Accountant John H. Bickley in assailing the interest charges of the A. T. & T. in its temporary loans or advances to the Bell System companies tried to develop that the A. T. & T. charged an interest surcharge or financial fee in its license contract service costs in addition to its regular interest rate for these advances of 5.88 per cent. The A.T. & T. in a review of his report declared the license service contract payments had been insufficient to pay for any service other than engineering and research so that it was impossible to add an interest surcharge. Bickley, however, claimed that all interest charges for these advances should have been at a rate of 5 per cent and the excessive interest assessment should be refunded to the Associated Companies.

● Another Investigation study alleged that the Long Lines Department of the A. T. & T. in taking over interstate traffic had taken the "cream" of the business from the Associated Companies and that there had also been the aim of evading state commission regulation for the A. T. & T. The Investigation staff produced a number of accounting and statistical records about telephone operations by states and by exchanges, which had been gleaned from Bell System companies' files, and claimed that this material thus had become available for state commission regulatory use for the first time and was highly valuable. The accusation of failure of the Bell System to adhere to the principles of the 1922 Hall memorandum came in a bulky Investigation study of the history of the Bell System which disclosed that two A. T. & T. vice-presidents had interrogated the Bell companies in 1925 and 1927 about potential purchases of Independent companies.

Making Equipment Survey

Work on a survey of telephone equipment in Hico, Tex., with a view to the elimination of obsolete equipment and the betterment of service in general, has been carried on by J. N. Hopper, district manager of the Gulf States Telephone Co.

Entirely NEW in Telephony!

VINCENT RARE GAS RELAY

Improves Ringing and Transmission on Party Lines Used with Either Coded or Harmonic Bells.
Low Cost. Installed with a Single Screw.
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Makers of
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Test-O-Lite, Etc., for 30 Years

Switchboard Maintenance

(Continued from page 22)

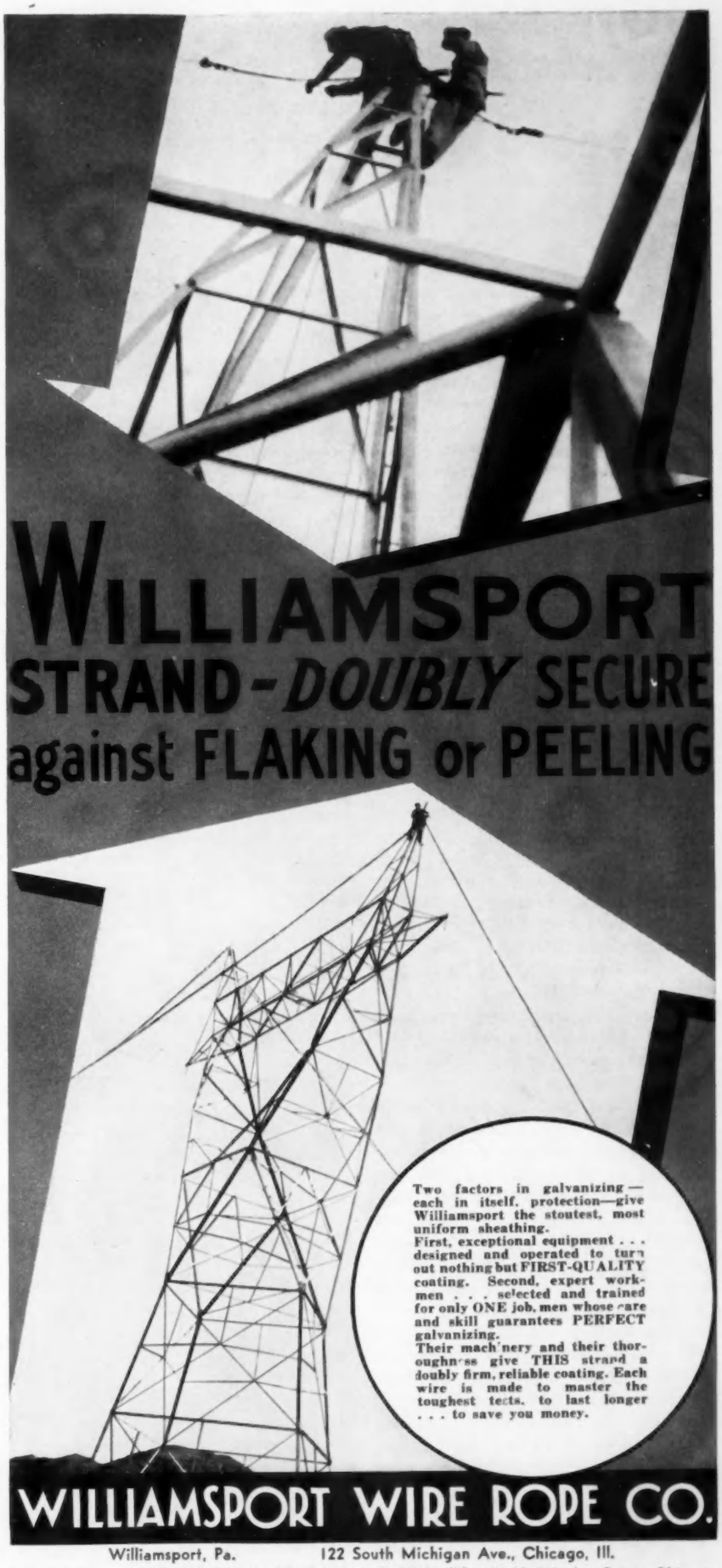
Connect the test receiver cord clips across the terminals of condenser "A", make and break one of the test cord connections, if no click is heard in the test receiver the condenser is short circuited. To test the primary winding of the induction coil for being open, connect one test clip to negative battery and touch the other clip to each terminal of the winding at points "P and P", if a click is heard at one terminal, winding is open.

● The above tests cover points when the P. B. X. operator cannot be heard. If the operator cannot hear and the trouble is believed to be due to an open in the secondary winding of the induction coil, operate one or two of the switchboard cord circuit listening keys and connect the cord clips of the test receiver across the terminals of condenser "B". While listening with the test receiver, connect and disconnect the operator's telephone set plug to its jack several times, if a click is heard each time the plug is inserted and withdrawn the secondary circuit is O. K.

To test for a short in the induction coil secondary winding, operate a listening key, plug the operator's telephone into its jack, connect the clips of a short cord across the terminals of condenser "B", connect the test receiver cord clips across terminals "L" and "R" of the induction coil and while listening in the test receiver disturb the operator's set transmitter, if sound is heard in the test receiver this part of the secondary winding is O. K. Now connect the test set clips across the terminals "R and R L" and repeat the test, if sound is heard the winding is O. K., if no sound is heard on either test it indicates a short circuit. In this manner it is possible to quickly locate trouble in the apparatus of the operator's telephone circuit without disconnecting any part of the circuit arrangement.

● Defective switchboard cord circuit key contacts or loose key connections can be detected by means of the apparatus and circuit arrangements as shown in figure 4. To test, insert the plug of one cord pair being tested into jack No. 1 and the plug of the other cord of the pair into jack No. 2. While listening in the test receiver move the lever of the key rapidly sideways several times (do not operate the key).

If the key springs are making good contact, or no loose connections exist, no sound should be heard in the test receiver, if not the receiver will indicate the condition by a scratching sound or noise. After completing tests, all the switchboard equipment should be returned to its normal operating condition.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Minnesota Association Selects J. P. Keane

WHEN the Minnesota Telephone Association holds its annual convention each year several things are taken for granted: a well diversified program arranged painstakingly and with care by its secretary J. C. Crowley, Jr., and a get-together banquet and dance that is remembered by the delegates, to provide added incentive to attend the following year. The meeting held in St. Paul, January 19, 20 and 21, was no exception. Keeping its reputation of being abreast of the times, the assemblage were treated to discussions about subjects affecting them most at this time. Rural electrification, Social security, impending legislation, rural collections and kindred problems of rural lines.

Probably setting examples for other state associations for their 1937 discussions, this meeting was one of the most successful ever enjoyed. Action of the by-laws committee in changing the directors from 10 to 15 in number was followed by the election of officers and directors. Illness of Secretary Crowley during the meet only demonstrated more forcibly the value of careful planning on conventions of this nature as the officers combined in carrying the plans out perfectly while its secretary was absent. The election held on the 21st resulted in the election of J. P. Keane, Pine Island Telephone Co., president; H. F. Leuders, Carver County Telephone Co., vice.president; and Mr. Crowley, Jr., was again selected as secretary-treasurer.

● Growth of the association has been steady. Numbering 216 members, 37 of which are associate, the retiring presidental, F. C. Marvin, of Zumbrota, was very proud of the increase in membership and the unusual turnout of members to their annual meeting this year. His address to the convention was well prepared and was one of the highlights of the sessions. Discussing the principal events of the year past with especial emphasis on the work of the association, Mr. Marvin also brought attention to depreciation with explanatory remarks that will no doubt be of invaluable assistance to members that have formerly treated this matter lightly. His remarks at the opening of the three day session were marked by kind reference to the death of the late F. B. MacKinnon and the illness of secretary Crowley. Mr. A. E. Wilcox of Bricelyn, was absent for the first time in many years because of illness.

The entertainment planned by the secretary was enjoyed to the fullest. The dinner for the assemblage was well attended with guests from the Minnesota Legislature and the Minnesota Railroad & Warehouse Commission. If Mr. Crowley could have been present to see the fruition of his plans as carried out by the combined efforts of everyone, he would have received many well earned congratulations.

"Rural Electrification" as explained by Dean Holm, associate consultant of the Minnesota Natural Resources Commission, covered the study made by that body in Minnesota. Stating that $3,500,000 had already been assigned by REA during 1936, he immediately remarked that a total of $15 000,000 to $20,000,000 would probably be approved during 1937. Cooperation between the utilities was stressed, also report on construction already built and how it weathered the recent sleet storms. This subject will probably be discussed in most of the conventions during the year and realizing such, the January issue of TELEPHONE ENGINEER carried two articles on this subject.

● Directors selected were: 3-year term —Vies Martinsen of Sebeka; P. M. Ferguson of Mankato; J. P. Keane of Pine Island; Jay Greaves of Glencoe, and F. C. Marvin of Zumbrota. 2 year term —P. A. Glaeser of Waconia; Warren B. Clay of Hutchinson; H. P. Sentman of Fairmont; Irving Todd of Hastings; and Charles R. Cashell of Worthington. 1 year term—G. M. Dwelle of Lake City; Leland Wright of Alexandria; S. A. Rask of Blooming Prairie; W. A. Eckles of Blue Earth; and H. F. Leuders of Norwood.

J. C. Crowley, Jr., Secretary

President-elect J. P. Keane

Sound movies furnished by the Northwestern Bell Telephone Co. were shown and proved very popular. Addresses were presented by many well known authorities. Among them: Miss Zina Ackmann of the Redwood County Telephone Company; Mr. Jay Greaves, president of the McLeod County Telephone Co., Glencoe; Mr. Frank Starkey, chairman of the Minnesota Dept. of Labor and Industry; and R. V. Achatz, general manager, Southern Indiana Telephone Co., Aurora, a former editor of TELEPHONE ENGINEER.

● A very representative list of manufacturers and suppliers were introduced to the assembled convention. A glance at the current issue of TELEPHONE ENGINEER will find practically all of these firms represented in our advertising columns.

Texas Utilities Commission Aim of Legislators

Presentation to the Texas Legislature of a bill to regulate rates and accounting systems of telephone, gas, electric and telegraph companies by the formation of a three-man commission, connects the name of Ed Clark, former private secretary to Gov. Allred, and now secretary of state, as its proposed chairman. The bill was presented by Representative Knetsch of Seguin, Texas.

Telephone Transmission—Theory and Practice

(Continued from page 15)

suppose the west balance is 6 db and the east balance 24 db this totals 30 db singing point for the two lines. In other words the gain dials of the repeater could be set up to 15 db each at which point the repeater would start to sing. If we then dropped back 3 db on each dial netting a total of 12 db, the circuit would be reasonably stable. This condition would be equally as satisfactory as if we had a circuit with singing points of 15 db on both sides of the repeater.

● The procedure to be followed in setting up a long repeatered telephone circuit is as follows. The transmission losses in each section should be measured, also the line impedance characteristics, at each point a repeater will be located. In general the repeaters should be spaced so that the transmission loss between them will not exceed about 12 or 15 db under extreme weather conditions. This means that under normal operating conditions the sections of the line between repeater points should not exceed about 10 db. After locating the repeater points and adjusting the networks to obtain the best singing points the repeaters should be adjusted to give the required calculated gains to maintain the desired over-all transmission characteristic. In general, this should be maintained at approximately 10 db. Such a circuit will provide good transmission between local telephones and allow for short extensions without the necessity for additional repeaters when such connections are set up.

After setting up the circuit, a transmission measurement in each direction should be made and checked against the calculated value. If there is any appreciable deviation from the computed value (more then 3 or 4 db) a check should be made to determine the cause of the descrepancy. This can best be accomplished by patching out one repeater at a time and making an overall transmission measurement. The gains of each repeater point can thus be determined and any errors corrected. The variation in line transmission equivalent must also be taken into consideration as weather conditions may change the equivalent from 2 to 3 db per repeater section. If transmission meters are available at the repeater points a check can be made along the line to determine the source of high transmission equivalent. The procedure in such cases consist of sending tone (generally 1,000 cycles) first from one end of the line and then the other and measuring the transmission equivalent to each repeater point. In this way the transmission equivalents of each section of line and the gain of each repeater can be obtained. It is desirable when measuring the transmission equivalent through a repeater to terminate the network with 600 ohms when the transmission meter is connected to the line side. This affords a somewhat better balance then would be obtained with the line balancing network and prevents any error due to such unbalance.

After a circuit has been once correctly lined up, a transmission frequency run should be made, this consists of measuring the overall transmission equivalent of the circuit at different frequencies. Generally five frequencies are sufficient as follows, 300, 500, 1,000, 1,500 and 2,000. In general the transmission equivalent at these frequencies should not exceed the 1,000 cycle equivalent by more than plus or minus 2 or 3 db.

THE AUTHOR

In answer to numerous requests, we take pleasure in introducing the author, Robert A. Clark, Jr., 504 N. Parkside Ave., Chicago. The present series on *Telephone Transmission —Theory & Practice* has proven one of the most interesting and instructive treatises it has been our pleasure to present to our readers. A graduate of University of Wisconsin Class '23, he served four years with the long lines department of the American Telephone and Telegraph Company, then eight years with Frank F. Fowle & Co. Consulting Engineers. Leaving to head his own organization specializing in long distance telephone transmission problems, he has earned a reputation as consulting engineer chiefly with his work on inductive coordination and telephone problems.

● With the circuit properly lined up a maintenance procedure should be followed to see that the over-all transmission equivalent is maintained. Routine measurements made periodically at 1,000 cycles are generally sufficient for this purpose. Occasionally the transmission frequency run should be repeated to see that the original characteristics are maintained.

A simple record for keeping the circuit data is shown in Fig. 68. All of the data need not be recorded on the perodic line up but spaces are available for completing the record when sectionalized tests are necessary to locate trouble. On important circuits involving several repeaters it is desirable to make over-all transmission measurements daily and on extremely long circuits (over 1,500 miles) tests twice daily are desirable. Only in this way can transmission equivalents be maintained. On short circuits involving but one repeater weekly tests should be sufficient. By keeping records as shown in Fig. 68 trouble can be quickly located.

● Records of repeater operation should be maintained at each repeater point and periodically forwarded to the control office. A suggested form for maintaining repeaters is shown in Fig. 69. The frequency of tests on repeaters depends somewhat on the length of the circuit. In general, the repeaters should be tested not less than once a month and on long circuits at least once a week. In this connection when making singing point tests on a repeater the gain dials at the next adjacent repeater point should be set on zero. When testing toward the terminal of a circuit it should be terminated either with a 600 ohm resistor or a telephone subset. The telephone subset is the most convenient as it is then merely necessary for the test board man to call the distant operator and have her connect the circuit to a telephone and take the receiver off the hook.

The record of a typical telephone circuit is shown in Fig. 68 and 69 which indicates the method of filling out the form and incidentally represents a good circuit line up.

(To be continued)

Granite Falls Exchange Gives 1936 Report

The excellent condition of the Granite Falls (Minn.) Telephone Company was told by manager G. L. Wilder in the recent annual meeting held at the home office. Increases in revenue and telephone installations were cited. Value of the plant and fixtures were shown to more than double the outstanding stock.

The company has in operation 14,520 feet of aerial cable, 3,960 feet of underground cable, 124 miles of rural pole line, 447 miles of rural wire, 4,004 poles, 158 rural telephones and 477 city telephones.

Four new directors were elected at the meeting. John Agre to fill the unexpired term of Helmer Hanson, H. O. Enstad to fill the unexpired term of C. G. Johnson, Geo. Dillingham to fill the unexpired term of K. E. Neste and A. E. Batchelder to succeed himself.

C. E. Wilson, president of the company presided at the meeting and read a resolution in memory of the three directors who have passed away the past year—K. E. Neste, Helmer Hanson and C. G. Johnson.

THE SAFE ANCHOR FOR R.E.A. CONSTRUCTION!

For long life and economy in annual maintenance costs, Everstick Anchors are first choice in rural electrification construction. Their safety and dependability have been proven on millions of miles of electric lines.

Anchors for Every Purpose!

The complete line of Everstick Anchors offers three expanding types in a complete range of sizes and holding capacities. Also rigid type Cone Anchors in all sizes. Made of malleable iron with its properties of strength, elasticity and rust resistance. Write for new bulletin "Everstick for Rural Electrification."

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Reduce Line Clearing Costs with Seymour Smith TELEPHONE PRUNERS

This powerful pruner cuts closer, is stronger than any other similar tool on the market. Can be operated in close tangled growth; cutting easily and cleanly branches up to 1½" in diameter. No trouble with spring breakage.

Here is the only pruner with the famous Seymour Smith "Center Cut" construction; safety catch to lock blade closed; one piece tempered tool steel blade; reinforced hook; extra long life spring; ball bearing pulley; highest quality chain; unbreakable iron head.

Designed by experts for experts; demanded by public utility companies everywhere, it will pay you to write for literature and prices.

SEYMOUR SMITH & SON, Inc.

132 Main Street
OAKVILLE, CONNECTICUT

Death Claims Archibald Wray

Archibald Wray, formerly of Janesville, Wisconsin, passed away suddenly on the morning of January 18 at the railway station of Park Ridge, Illinois, his home. Mr. Wray was born on June 17, 1879 at Janesville, Wisconsin and attended the Janesville schools. In 1894, he went to Chicago where he entered the employ of the Chicago Telephone Company in the Engineering Department and was later employed as Assistant Chief Inspector of the American Telephone & Telegraph Co. in the central west district. Through his association with J. G. Wray & Co. during the past eighteen years he has been connected with many important rate investigations of telephone companies and other utilities.

He was co-inventor of the first successful railway train dispatching system by telephone which was introduced on the system of the C. B. & Q. Railroad. He was also co-inventor of a system of typewriter telegraph and patented a radio antenna. His suggestion to U. S. Navy, during war times, on his plan to cup shells to prevent richochet was recognized.

Mr. Wray was a Mason and a member of the Independent Pioneers Telephone Association. For a number of years he was a member of the school board of Park Ridge, Illinois.

He is survived by his wife and his daughter, Jean, of Park Ridge, and by two sisters, Mrs. A. L. Raynor, Antigo, Wisconsin, and Mrs. S. S. Cheney, Evanston, Illinois, and by four brothers, Mr. Edward Wray of Evanston, Illinois, Mr. Charles Wray of Calgary, Alberta, Dr. William E. Wray of Campbell, Minnesota, and J. C. Wray of Glencoe, Illinois.

Crapo GALVANIZED PRODUCTS

Where strains and stresses are heaviest, where corrosion takes its greatest toll, *Crapo* Galvanized Telephone Wire and Steel Strand long ago demonstrated their outstanding superiority. The heavy *pure* zinc galvanized coating, maximum tensile strength and proper ductility insure longer life and lower maintenance cost. Insist upon *Crapo* Galvanized Products for better performance under all conditions!

Indiana Steel & Wire Co.
Muncie, Indiana

Crapo Galvanized Products are available in all standard grades and sizes.

UNIQUE
Cable Splicers' TOOLS

FURNACES
BLOW-TORCHES
FOLDING WIND SHIELDS
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No. 3 Blow-Torch

No. 55 Furnace

No. 50 Folding Shield

Literature?

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221 W. Whiting St., Chicago, Ill.

6 POINTS OF SUPERIORITY IN THESE NEW LENZ TELEPHONE CORDS

1 NEW CELLULOSE ACETATE INSULATION

With improved moisture-resisting and body-acid resisting qualities. Its improved insulation resistance minimizes possibilities of electrical leakage.

2 MAXIMUM FLEXIBILITY

Cords of three conductors or more are twisted together so as to give maximum flexibility, uniformity and less liable to kink.

3 LONG WEARING OUTER BRAID

The finest wear resisting textile available is used in outer braid, assuring long life.

4 BRONZE ALLOY CONDUCTORS

The Double Wrapped Conductor Ribbon is Bronze Alloy, selected for its greater physical strength and ability to withstand hard usage without breaking.

5 MOISTURE-PROOF IMPREGNATION

The CELLULOSE ACETATE insulation is impregnated with a special non-corrosive moisture-proof compound providing additional protection against electrical leakage.

6 SUPERIOR WORKMANSHIP

Each cord is manufactured in accordance to the highest standards of workmanship, and thoroughly tested.

SEND FOR SAMPLE CORD TODAY!
We will gladly submit sample Lenz Telephone Cord for your personal inspection.

HAVE YOU RECEIVED YOUR FREE LENZ CORD CHART?
For all types of switchboards and instruments, FREE to Telephone engineers and managers!

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World's largest manufacturers of storage batteries for every purpose.

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Only ONE Contact!
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(See our space in next month's issue)

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ANDERSON, INDIANA	ANDERSON HOTEL
TERRE HAUTE, INDIANA	TERRE HAUTE HOUSE
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PICK HOTELS

THE WORD **PICK** SHOULD ALWAYS REMIND YOU OF ALBERT PICK HOTELS

More Hours of Service

. . . that's what every telephone engineer seeks . . . *more hours of service* . . . which means fewer replacements, lower service costs! And that's exactly what Ray-O-Vac telephone batteries offer!

For 3 decades Ray-O-Vac batteries have met and exceeded specifications and requirements on every recognized telephone and light intermittent test, and surpass all government standards. For lower service costs, specify Ray-O-Vac!

RAY-O-VAC COMPANY
Formerly FRENCH BATTERY COMPANY
MAIN OFFICES AND PLANT
MADISON, WISCONSIN
Additional Factories at Clinton, Massachusetts and Lancaster, Ohio

A. B. Chance Company Holds Sales Conference

Representatives of the A. B. Chance Company, manufacturers of anchors, guying fixtures and other pole line equipment met for their annual sales conference during January at the factory in Centralia, Mo.

The picture shows a few of these men around the conference table. They are from left to right—

O. E. Walker, Factory manager; V. E. Coe, central states representative; W. A. Moss, Pacific Coast representative; C. L. Clark, Eastern representative; J. T. Isbell, Gen. Sales Mgr.; E. G. Ryman, Ass't Sales Mgr.; F. G. Chance, Vice-Pres.; A. C. Wilson, S. E. representative; J. J. Milligan, Chicago representative; C. C. Musgrove, S. W. representative.

Other members of the organization attending but not shown are—

A. B. Chance, President; T. B. Dally, New York City representative; D. C. Garroway, New England representative; H. A. Houston, Adv. Mgr.

A discussion of general business conditions throughout the country gave cause for optimism as did a summary of the years business which revealed that on many items the company had more than doubled its 1935 business and all its items had shown an increase.

Several new products were introduced and enthusiastically accepted. The company plans an increase in advertising for 1937 and a big increase in sales all over the country.

Larkin & Company Enlarge Clientele

Announcement by John C. Larkin & Company of the acquisition of the business of J. K. Johnston, retired, telephone engineer of Indianapolis, is of much interest to the telephone industry. Serving the industry for nearly 25 years, J. K. Johnston retires with the knowledge that his former clients will be in able hands due to his foresight in sec-

(Please turn to page 36)

CHICAGO'S
NEWEST HOTEL
OFFERS
Free Radio Loud Speaker
Circulating Ice Water
Tub Bath or Shower in every room
Garage . . . with direct entrance to hotel
RATES
From $2.00 Single
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400 ROOMS FIREPROOF
HARRISON HOTEL
HARRISON STREET
(Just off Michigan Blvd.)
ANDREW C. WEISBURG, President
EDWARD W. JACKS, Manager
Illustrated booklet sent upon request

Family of Mr. Mackinnon To Receive Beautiful Tribute

A beautiful hand engrossed and Italian illuminated Memorial Resolution containing the Resolutions passed by the members of the executive committee of the United States Independent Telephone Association on January 13th will be presented the family of the late Frederick Benjamin MacKinnon former president of their association.

Bound in blue levant morocco, this wonderful gift from the association he served so faithfully, was designed and executed by Maurice L. Harris of Chicago. Engrossed and illuminated in Gold, Green and Purple on genuine sheepskin, the pages are handsomely hand done throughout and contains the tribute and the names of the directorate of the association that the family might know the high esteem in which their loved one was held.

The title page is dedicated as "A Tribute to the Memory of Frederick Benjamin MacKinnon" and will be presented to the family in the near future. It is truly a masterpiece of design and beauty. The painstaking minute workmanship was handled perfectly by its designer and the entire association can well be proud of the action by their directors in this lovely gift to their former leader.

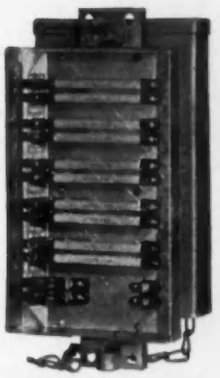
FLASH!

Oscar Burton, Tyler, Tex., is another president. Action of his home town Chamber of Commerce in elevating him to their head on February 9th is another honor to the president of the Texas Telephone Association. Besides serving as president to the above organizations, Mr. Burton is the capable general manager of the Gulf States Telephone Co. with offices in Tyler.

He will preside at the Texas convention during mid-March and we look forward to attending this meeting prepared by Oscar and their able association secretary, H. M. Stewart. To give personal congratulations to Mr. Burton on his new honor will be a real pleasure to an old friend.

COOK

New



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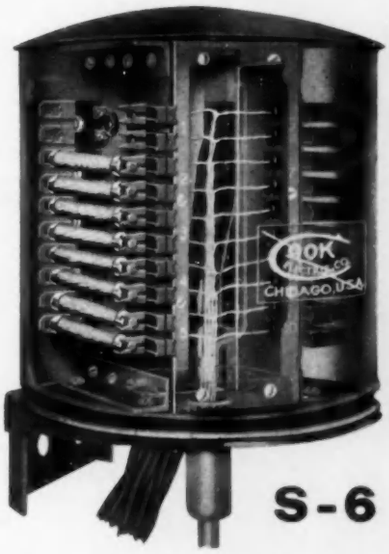

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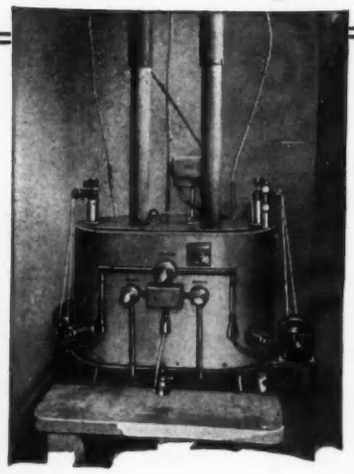

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Larkin & Company Enlarge Clientele

(Continued from page 34)

uring Larkin & Company to carry on in the appraisal and engineering work he has pioneered. His customers numbered over 750 during his active service. He is sec.-treas. of the Pioneer Telephone Association of the United States.

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HELP!

We are offering $1.00 cash for each of the following issues of TELEPHONE ENGINEER: September, October, November and December 1919. January, February, March, April, June and December 1920.

If you have any of these copies please write us immediately before mailing any of these copies as we only need one of each.

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Walter J. Uhl Recovers

Winning a battle against pneumonia, Walter J. Uhl, Logansport, Ind., of the Indiana Associated Telephone Corp., is now up and about again. He was stricken during Christmas while on a trip to Chicago and immediately returning home because of this the seriousness of the attack necessitated his confinement.

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